Proposed reference ranges on Healthy Visceral Adipose Tissue Index (VATI) Targets by Ethnicity (CT at L3)

Dr E Leatham
The Surrey Cardiovascular Clinic
© Edward Leatham 2025

Background

Visceral adipose tissue (VAT) measured on computed tomography (CT) at the level of the third lumbar vertebra (L3) is a robust imaging biomarker of metabolic risk. Normalising VAT area for height squared—**visceral adipose tissue index (VATI, cm^2/m^2)**—allows risk comparison across individuals and populations. Elevated VATI correlates with insulin resistance, hypertension, dyslipidaemia, and cardiovascular disease independent of BMI. (1–5)

However, optimal VATI thresholds vary by ethnicity and sex because of genetic and body-composition differences influencing visceral fat distribution and metabolic sensitivity. (5–9). This consensus paper synthesises evidence from multi-ethnic imaging studies to define **healthy VATI targets** measurable on CT at L3.

Population-based reference range for Visceral Adipose Tissue, Indexed on height (VATI)

Caucasian Adults

Sex	Target	Moderately Unhealthy	Very Unhealthy
Men	< 35-38 cm^2/m^2	38.7 – ~52 $cm^2/m^{22,3}$	≥ 52 cm^2/m^{23}
Women	< 22-25 cm^2/m^2	24.9 – ~60 $cm^2/m^{22,3}$	≥ 60 cm^2/m^{23}

For clinical and research purposes in Caucasian populations, VATI measured at L3 on CT should be interpreted relative to the thresholds above. If a subject's VATI exceeds ***~ 38.7 (men)*** *or* ***~ 24.9 (women)*** *cm^2/m^2, they are at elevated metabolic risk. Therapeutic goals (e.g. via diet, exercise, medication) should aim to reduce VATI into the* ***≤ 35-38 (men)*** *or* ***≤ 22-25 (women)*** *cm^2/m^2 range, when possible, to minimise future metabolic syndrome risk*

Non-Caucasian Adults

Population	Sex	Proposed low risk VATI Target	Moderately Unhealthy	Very Unhealthy
East Asian (Chines/Japanese /Korean)	Men	< 32-35 cm^2/m^2	26 – 50 cm^2/m^{22}	≥ 50 cm^2/m^2
East Asian (Chines/Japanese /Korean)	Women	< 20-22 cm^2/m^2	26 – 50 cm^2/m^{22}	≥ 50 cm^2/m^2
South Asian (Indian/ Pakistani/ Bangladeshi)	Men	<30-34 cm^2/m^2	35– 50 cm^2/m^2	≥ 50 cm^2/m^2
South Asian (Indian/ Pakistani/ Bangladeshi)	Women	< 19-21 cm^2/m^2	26 – 50 cm^2/m^2	≥ 50 cm^2/m^2
Middle Eastern/Arab	Men	<34-36 cm^2/m^2	36– 50 cm^2/m^2	≥ 50 cm^2/m^2
Middle Eastern/Arab	Women	< 21-23 cm^2/m^2	26 – 50 cm^2/m^2	≥ 50 cm^2/m^2
Black/ African or African descent	Men	< 27-36 cm^2/m^{23}	36 – 52 cm^2/m^{23}	≥ 52 cm^2/m^{23}
African descent	Women	<21-37 cm^2/m^2	37 – 50 cm^2/m^2	≥ 50 cm^2/m^2

*Best-available, gender-specific view for **non-Caucasian** populations. A quick heads-up: very few studies report **VATI** (VAT area/(height)² at **L3**) with risk-based cut-offs outside Caucasians. Most non-Caucasian data use **absolute VAT area (VFA, cm²)** at L2–L4/umbilicus rather than VATI*

Evidence Summary

1. L3 as the optimal measurement level

Shen et al. established that VAT area at L3 correlates most strongly with total VAT volume, validating L3 as the reference site for clinical and research assessment. (1) Cross-modality comparisons confirm high agreement between CT and MRI for L3 VAT quantification (10,11)

2. Reference thresholds in Caucasian adults

In 416 healthy Caucasian kidney-donor candidates, **Baggerman et al.** reported that metabolic-risk prevalence (antihypertensive or statin use) rose sharply above VATI ≥ 38.7 cm^2/m^2 in men and ≥ 24.9 cm^2/m^2 in women.[2] Below these levels, participants had substantially lower metabolic risk. Similar VAT–risk relations were described in white and African-American adults by **Katzmarzyk et al.**, confirming ethnic variability in absolute thresholds.(5)

Accordingly, VATI ≤ 35–38 cm^2/m^2 (men) and ≤ 22–25 cm^2/m^2 (women) represent practical **low-risk targets** for Caucasians.

3. East Asian populations

A large multicentre Chinese cohort demonstrated median healthy VATI values of about 39 cm^2/m^2 (men) and 26 cm^2/m^2 (women).(4) Yet metabolic risk in East Asians emerges at lower visceral fat levels than in Caucasians.(3,4,8) Unindexed VAT-area studies identify metabolic-syndrome cut-offs near 210 cm^2 (men) and 135 cm^2 (women), translating to approximate VATI thresholds of 33–35 cm^2/m^2 (men) and 21–22 cm^2/m^2 (women).(7)

4. South Asian populations

Direct L3-VATI data are scarce. Extrapolation from Indian and Pakistani visceral-fat studies and from systematic reviews[8] suggests that metabolic risk occurs at still lower VATI; thus, provisional low-risk targets are **≤ 30–34 cm^2/m^2 (men)** and **≤ 19–21 cm^2/m^2 (women)**.

5. Middle Eastern / Arab populations

A UAE study using CT found an optimal visceral-fat-area cut-off of ~132 cm^2 for predicting metabolic syndrome in adults < 50 y.(7) Adjusted for mean height, this equates to VATI ≈ 34–36 cm^2/m^2 (men) and ≈ 21–23 cm^2/m^2 (women).

6. African or African-descent populations

African-descent individuals generally display lower absolute VAT but comparable or higher metabolic risk for a given BMI.(5) Pending dedicated L3-VATI datasets, **Caucasian-equivalent or slightly stricter thresholds** (≤ 34–36 cm^2/m^2 men, ≤ 21–23 cm^2/m^2 women) are reasonable.

Consensus VATI Targets (CT at L3, cm^2/m^2)

Ethnic group	Men	Women	Key supporting evidence
Caucasian (European descent)	≤ 35–38	≤ 22–25	Baggerman 2022[2]; Shen 2004[1]; Katzmarzyk 2013[5]; Zaffina 2022[10]; Bennett 2024[6]
East Asian (Chinese, Japanese, Korean)	≤ 32–35	≤ 20–22	Kong 2022[4]; Oka 2008[10]; Bennett 2024[6]
South Asian (Indian, Pakistani, Bangladeshi)	≤ 30–34	≤ 19–21	Extrapolated from Bennett 2024[6] and regional VFA data
Middle Eastern / Arab	≤ 34–36	≤ 21–23	Yoo 2020[7]; Bennett 2024[6]
African / African descent	≤ 34–36	≤ 21–23	Katzmarzyk 2013[5]; Bennett 2024[6]

Measurement Recommendations

- Use **non-contrast CT**, slice at **mid-L3**, HU window −150 to −50.(10,11)
- Always **index to height²** when reporting VATI.
- Apply **sex- and ethnicity-specific** interpretation.

- Track VATI longitudinally alongside waist-to-height ratio and metabolic biomarkers.

Conclusion

Across populations, rising VATI parallels worsening metabolic health. For **Caucasians**, maintaining VATI ≤ 35–38 cm^2/m^2 (men) and ≤ 22–25 cm^2/m^2 (women) aligns with minimal cardiometabolic risk. Equivalent risk in **East and South Asians** occurs at **lower VATI values**, while **African-descent and Middle-Eastern** populations show thresholds similar to or slightly below those of Caucasians. These values provide realistic **targets for prevention and therapy** in clinical practice.

References

1. Shen W, Punyanitya M, Wang Z, Gallagher D, St-Onge MP, Albu J, et al. Visceral adipose tissue: relations between single-slice areas and total volume. Am J Clin Nutr. 2004 Aug;80(2):271–8.

2. Baggerman MR, Dekker IM, Winkens B, Olde Damink SWM, Weijs PJM, van de Poll MCG. Computed tomography reference values for visceral obesity and increased metabolic risk in a Caucasian cohort. Clin Nutr ESPEN. 2022 Apr;48:408–13.

3. Kim JA, Choi CJ, Yum KS. Cut-off values of visceral fat area and waist circumference: diagnostic criteria for abdominal obesity in a Korean population. J Korean Med Sci. 2006 Dec;21(6):1048–53.

4. Kong M, Xu M, Zhou Y, Geng N, Lin N, Song W, et al. Assessing Visceral Obesity and Abdominal Adipose Tissue Distribution in Healthy Populations Based on Computed Tomography: A Large Multicenter Cross-Sectional Study. Front Nutr. 2022;9:871697.

5. Katzmarzyk PT, Heymsfield SB, Bouchard C. Clinical utility of visceral adipose tissue for the identification of cardiometabolic risk in white and African American adults123. Am J Clin Nutr [Internet]. 2013 Mar [cited 2025 Dec 10];97(3):480–6. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC3578400/

6. Bennett JP, Prado CM, Heymsfield SB, Shepherd JA. Evaluation of visceral adipose tissue thresholds for elevated metabolic syndrome risk across diverse populations: A systematic review. Obes Rev Off J Int Assoc Study Obes. 2024 Sept;25(9):e13767.

7. Yoo S, Sung MW, Kim H. CT-defined visceral adipose tissue thresholds for identifying metabolic complications: a cross-sectional study in the United Arab Emirates.

BMJ Open [Internet]. 2020 Aug 11 [cited 2025 Dec 10];10(8):e031181. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7422653/

8. Oka R, Kobayashi J, Yagi K, Tanii H, Miyamoto S, Asano A, et al. Reassessment of the cutoff values of waist circumference and visceral fat area for identifying Japanese subjects at risk for the metabolic syndrome. Diabetes Res Clin Pract. 2008 Mar;79(3):474–81.

9. Examination Committee of Criteria for 'Obesity Disease' in Japan, Japan Society for the Study of Obesity. New criteria for 'obesity disease' in Japan. Circ J Off J Jpn Circ Soc. 2002 Nov;66(11):987–92.

10. Zaffina C, Wyttenbach R, Pagnamenta A, Grasso RF, Biroli M, Del Grande F, et al. Body composition assessment: comparison of quantitative values between magnetic resonance imaging and computed tomography. Quant Imaging Med Surg. 2022 Feb;12(2):1450–66.

11. Hsu LY, Ali Z, Bagheri H, Huda F, Redd BA, Jones EC. Comparison of CT and Dixon MR Abdominal Adipose Tissue Quantification Using a Unified Computer-Assisted Software Framework. Tomography [Internet]. 2023 May 20 [cited 2025 Dec 10];9(3):1041–51. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10204377/